

CLAIMS

What is claimed is:

1. A functionalized composition for use in forming an immunonanoparticle, said functionalized composition comprising:
 - a nanoparticle-forming polymer;
 - a polymeric strand having a first end attached to said nanoparticle-forming polymer and a second end;
 - a conjugation agent attached to the second end of said polymeric strand.
2. A functionalized moiety for use in forming an immunonanoparticle according to claim 1 that further includes a targeting agent attached to said conjugation agent.
3. A functionalized composition for use in forming an immunonanoparticle according to claim 1 wherein said nanoparticle forming polymer is selected from the group consisting of poly(lactic acid), poly(glycolide), poly(lactide-co-glycolide), polybutylcyanoacrylate, poly(ϵ -caprolactone), monomethoxypoly(ethylene oxide)-poly(lactic acid), hexadecylcyanoacrylate, and copolymers thereof.
4. A functionalized composition for use in forming an immunonanoparticle according to claim 1 wherein said polymeric strand is selected from the group of polymers consisting of polyethylene glycol or sphingomyelin.
5. A functionalized composition for use in forming an immunonanoparticle according to claim 4 wherein said polymeric strand is polyethylene glycol that has a molecular weight of between 1000 and 50,000 Daltons.
6. A functionalized composition for use in forming an immunonanoparticle according to claim 1 wherein said conjugation agent is selected from the group consisting of a maleimide, hydroxysuccinimide, hydrazide, carboxylic acid, or a primary amine group.
7. A functionalized composition for use in forming an immunonanoparticle according to claim 5 wherein said conjugation agent is maleimide.

8. A functionalized composition for use in forming an immunonanoparticle according to claim 7 wherein said nanoparticle forming polymer is poly(lactic acid).

9. A nanoparticle composition comprising a plurality of functionalized compositions according to claim 1, said nanoparticle composition including a core comprising said nanoparticle-forming polymers and a corona surrounding said core that comprises said polymeric strands.

10. A nanoparticle composition according to claim 9 that comprises a plurality of non-functionalized compositions wherein each of said non-functionalized compositions comprises a nanoparticle-forming polymer and a polymeric strand having a first end attached to said nanoparticle-forming polymer and a second end and wherein said core includes nanoparticle-forming polymers from both said functionalized and non-functionalized compositions and wherein said corona includes polymeric strands from both said functionalized and non-functionalized compositions.

11. A nanoparticle composition according to claim 9 wherein the nanoparticle forming polymers of said functionalized compositions are selected from the group consisting of poly(lactic acid), poly(glycolide), poly(lactide-co-glycolide), polybutylcyanoacrylate, poly(ϵ -caprolactone), monomethoxypoly(ethylene oxide)-poly(lactic acid), hexadecylcyanoacrylate, and copolymers thereof.

12. A nanoparticle composition according to claim 10 wherein the nanoparticle forming polymers of said non-functionalized compositions are selected from the group consisting of poly(lactic acid), poly(glycolide), poly(lactide-co-glycolide), polybutylcyanoacrylate, poly(ϵ -caprolactone), monomethoxypoly(ethylene oxide)-poly(lactic acid), hexadecylcyanoacrylate, and copolymers thereof

13. A nanoparticle composition according to claim 9 wherein said polymeric strands of said functionalized compositions are selected from the group of polymers consisting of polyethylene glycol or sphingomyelin.

14. A nanoparticle composition according to claim 10 wherein said polymeric strands of said non-functionalized compositions are selected from the group of polymers consisting of polyethylene glycol or sphingomyelin.

15. A nanoparticle composition according to claim 13 wherein said polymeric strands comprise polyethylene glycol that has a molecular weight of between 1000 and 50,000 Daltons.

16. A nanoparticle composition according to claim 14 wherein said polymeric strands comprise polyethylene glycol that has a molecular weight of between 1000 and 50,000 Daltons.

17. A nanoparticle composition according to claim 15 wherein said polymeric strands of said non-functionalized compositions comprise polyethylene glycol that has a molecular weight of between 1000 and 50,000 Daltons.

18. A nanoparticle composition according to claim 10 wherein the molecular weight of the polymeric strands in said functionalized compositions is greater than the molecular weight of the polymeric strands in said non-functionalized compositions.

19. A nanoparticle composition according to claim 17 wherein the molecular weight of the polyethylene glycol strands in said functionalized compositions is greater than the molecular weight of the polyethylene glycol strands in said non-functionalized compositions

20. A nanoparticle composition according to claim 9 wherein said conjugation agent is selected from the group consisting of a maleimide, hydroxysuccinimide, hydrazide, carboxylic acid, or a primary amine group.

21. A nanoparticle composition according to claim 20 wherein said conjugation agent is maleimide.

22. A nanoparticle composition according to claim 9 wherein said nanoparticle forming polymer is poly(lactic acid).

23. A nanoparticle according to claim 9 wherein the size of said immunonanoparticle precursor ranges from 50 to 150 nanometers.

24. A nanoparticle composition comprising a plurality of functionalized compositions according to claim 2, said nanoparticle composition including a core comprising said nanoparticle-forming polymers and a corona surrounding said core that comprises said polymeric strands.

25. A nanoparticle composition according to claim 24 that comprises a plurality of non-functionalized compositions wherein each of said non-functionalized compositions comprises a nanoparticle-forming polymer and a polymeric strand having a first end attached to said nanoparticle-forming polymer and a second end and wherein said core includes nanoparticle-forming polymers from both said functionalized and non-functionalized compositions and wherein said corona includes polymeric strands from both said functionalized and non-functionalized compositions.

26. A nanoparticle composition according to claim 24 wherein the nanoparticle forming polymers of said functionalized compositions are selected from the group consisting of poly(lactic acid), poly(glycolide), poly(lactide-co-glycolide), polybutylcyanoacrylate, poly(ϵ -caprolactone), monomethoxypoly(ethylene oxide)-poly(lactic acid), hexadecylcyanoacrylate, and copolymers thereof.

27. A nanoparticle composition according to claim 25 wherein the nanoparticle forming polymers of said non-functionalized compositions are selected from the group consisting of poly(lactic acid), poly(glycolide), poly(lactide-co-glycolide), polybutylcyanoacrylate, poly(ϵ -caprolactone), monomethoxypoly(ethylene oxide)-poly(lactic acid), hexadecylcyanoacrylate, and copolymers thereof.

28. A nanoparticle composition according to claim 24 wherein said polymeric strands of said functionalized compositions are selected from the group of polymers consisting of polyethylene glycol or sphingomyelin.

29. A nanoparticle composition according to claim **25** wherein said polymeric strands of said non-functionalized compositions are selected from the group of polymers consisting of polyethylene glycol or sphingomyelin.

30. A nanoparticle composition according to claim **28** wherein said polymeric strands comprise polyethylene glycol that has a molecular weight of between 1000 and 50,000 Daltons.

31. A nanoparticle composition according to claim **29** wherein said polymeric strands comprise polyethylene glycol that has a molecular weight of between 1000 and 50,000 Daltons.

32. A nanoparticle composition according to claim **30** wherein said polymeric strands of said non-functionalized compositions comprise polyethylene glycol that has a molecular weight of between 1000 and 50,000 Daltons.

33. A nanoparticle composition according to claim **29** wherein the molecular weight of the polymeric strands in said functionalized compositions is greater than the molecular weight of the polymeric strands in said non-functionalized compositions.

34. A nanoparticle composition according to claim **32** wherein the molecular weight of the polyethylene glycol strands in said functionalized compositions is greater than the molecular weight of the polyethylene glycol strands in said non-functionalized compositions

35. A nanoparticle composition according to claim **24** wherein said conjugation agent is selected from the group consisting of a maleimide, hydroxysuccinimide, hydrazide, carboxylic acid, or a primary amine group.

36. A nanoparticle composition according to claim **35** wherein said conjugation agent is maleimide.

37. A nanoparticle composition according to claim **24** wherein said nanoparticle forming polymer is poly(lactic acid).

38. A nanoparticle composition according to claim **24** wherein the size of said immunonanoparticle precursor ranges from 50 to 150 nanometers.

39. A nanoparticle composition according to claim **10** wherein the ratio of functionalized compositions to non-functionalized compositions in said immunonanoparticle precursor is between 1:5 and 1:100.

40. A nanoparticle composition according to claim **25** wherein the ratio of functionalized compositions to non-functionalized compositions in said immunonanoparticle is between 1:5 and 1:100.

41. A nanoparticle composition according to claims **9-23 and 39** wherein said core includes a drug or diagnostic agent.

42. A nanoparticle composition according to claims **24-38 and 40** wherein said core includes a drug or diagnostic agent.

43. A method for making a nanoparticle composition comprising the step of combining a plurality of said functionalized compositions according to claim **1** to form an nanoparticle composition that includes a core comprising said nanoparticle-forming polymers and a corona surrounding said core that comprises said polymeric strands and treating said nanoparticle with a targeting agent that binds to said conjugation agents to form said nanoparticle composition.

44. A method for making a nanoparticle composition comprising the step of combining a plurality of said functionalized compositions according to claim **2** to form said nanoparticle composition that includes a core comprising said nanoparticle-forming polymers, a corona surrounding said core that comprises said polymeric strands and a plurality of targeting agents that are bound to said conjugation agents.

45. A method for making a nanoparticle composition according to claim **43** which comprises the step of combining a non-functionalized composition with said functionalized composition, said non-functionalized composition comprising a nanoparticle-forming polymer and a polymeric strand having a first end attached to said nanoparticle-forming polymer and a second end.

46. A method for making a nanoparticle composition according to claim 44 which comprises the step of combining a non-functionalized composition with said functionalized composition, said non-functionalized composition comprising a nanoparticle-forming polymer and a polymeric strand having a first end attached to said nanoparticle-forming polymer and a second end.

47. A method for making a nanoparticle composition according to claim 45 wherein the ration of functionalized compositions to non-functionalized compositions that are combined together to form said immunonanoparticle is between 1:5 and 1:100.

48. A method for making a nanoparticle composition according to claim 46 wherein the ratio of functionalized compositions to non-functionalized compositions that are combined together to form said immunonanoparticle is between 1:5 and 1:100.

49. A method for making a nanoparticle composition according to claim 43 that includes the additional step of incorporating a drug or diagnostic agent into the core of said immunonanoparticle.

50. A method for making a nanoparticle composition according to claim 44 that includes the additional step of incorporating a drug or diagnostic agent into the core of said immunonanoparticle.